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REPORT No. J-222-4 (Final Report)

CONTRACT No. DA-92-557-FEC-37767

AIR POLLUTION ASTHMA IN OSAKA, JAPAN

by

Ovid B. Bush, Jr., M.D.

Director of Research
Yodogawa Christian Hospital
Osaka, Japan

June 1967

U.S. ARMY RESEARCH AND DEVELOPMENT GROUP
FAR EAST
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ABSTRACT

During the past two and a half years, we have been studying two problems: The first: was the syndrome of "Tokyo-Yokohama Asthma" a separate and distinct syndrome or was it a group of three clinical entities? These three entities were: a. (true asthma, b. acute bronchitis, and c. chronic obstructive pulmonary disease) The second: whether the syndrome of "Tokyo-Yokohama Asthma" could be found in Osaka as well as in the Tokyo-Yokohama area?

We have intensively studied 146 patients and have complete records on 124. There have been 28 patients admitted to the hospital for from 1 to 8 times for intensive care and study. A standardized questionnaire, physical examination, laboratory tests, and spirometric studies, as well as the use of air conditioners and electrostatic precipitators for clean air rooms were used to evaluate these problems. The United States Public Health Service, Division of Air Pollution, also supplied equipment to us for measuring SO_2 and particulate levels.

We have found cases of each of the three clinical entities mentioned above. The cases have shown a response to the clean air environment and upon return to their homes some have again had respiratory difficulties. We have thus been able to answer to our satisfaction that the syndrome of "Tokyo-Yokohama Asthma" is in reality three distinct clinical entities and not a single syndrome. We have also been able to establish to our satisfaction that the clinical entities described above do occur in the Osaka area and we would suspect that they would occur in any area where there is a high level of air pollution and during seasons when there is a large number of respiratory illnesses. We have been unfortunate in not having large numbers of respiratory illnesses during the time of the study but we have been able to satisfy ourselves that there is a connection between air pollution and the severity and complications of respiratory illnesses.

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1. Introduction:

In 1946, American Military Physicians noted an increased number of asthma cases among troops in the Kanto Plain area of Japan. From the 406th Medical General Laboratory Annual Report of 1950[1], it is noted the the laboratory facility was initiated to study this problem as a result of the conference with the medical staff of the 155th Station Hospital, which had established the existence of a different type of asthma among occupation personnel. They found the cases to be located within the vicinity of Yokohama and the season for this particular problem was between the months of September and February.

In the Medical General Laboratory Annual Report for 1951[2], it was reported that the overall picture did not appear compatible with allergic asthma for several reasons: pollen counts were lowest during the "Asthma" season, antihistamine drugs were ineffective, no previous history of asthma was obtained, and the disease was confined to a small area. At that time, the report also noted that on the days preceded by little or no rain fall and, when the wind velocity was low, that the greatest incidence of asthma was found. It would seem from this that this would be the first report of possible connection with air pollution and "Yokohama Asthma."

The first published report of so-called "Yokohama Asthma" was made in 1953 by Redfearn and Karakawa[3]. They reported that their preliminary findings indicated that air pollution was a major cause of "Yokohama Asthma." They also noted that the air contaminants from ether soluble aerosols and dust had shown the best individual correlation with the incidence rates.

The first report of the disease itself was by Huber, et al. in 1954[4]. This report gave the clinical features of what was called a new environmental respiratory disease occurring in certain areas of Japan during the winter months among United States Military personnel.

In introducing the background thinking of the present study, it is interesting to note two reports by Maj. N. I. Condit[5, 6], in which a similar type of asthmatic entity occurring during the night seemed to have taken place in Okinawa.

Maj. H. W. Phelps in studying the problem of air pollution asthma among the military personnel in Japan has authored and co-authored several papers on the subject[7, 8, 9, 10]. These reports give the clinical features of this disease. They include: 1. Persons with no past history of asthma were afflicted. 2. Antihistamine drugs were ineffective. 3. Rapid resistance of bronchodilators ensued. 4. The disease was most frequent in the fall and winter. 5. Dramatic improvement occurred when the patient left the Tokyo-Yokohama area and relapse occurred on returning to the area. Later it was learned that the degree of pulmonary disability was far greater than had been originally appreciated, some patients showing signs of irreversible lung damage.

One of the reasons for studying the "Tokyo-Yokohama Asthma" syndrome in the Osaka area was to see if this syndrome occurred in another area of Japan. A report by Toshio Toyama[11] stated that it could be assumed that cases of "Tokyo-Yokohama Asthma" have been reported from the Japanese population, not as chronic asthmatic bronchitis associated with air pollution but rather as tuberculosis, classical asthma, or some other disease.

Intensive investigations of the cause of this illness were conducted by the 406th Medical General Laboratory from 1950 to 1957. It was learned, as noted above, that pollens were unlikely causes. As no correlation existed between pollen count and asthma cases observed, particularly as the asthma cases occurred when the pollen counts were the lowest, pollens were ruled out as a likely etiology and air pollution was thought to be the most probable etiology because of the large industrial complex in the Kanto Plain area. The frequent occurrence of smog in the winter time, together with the finding of exacerbations of symptoms with low rain fall and low wind velocity and an increased dust fall, made most observers feel that air pollution was much more likely to be a cause. It was felt that the disease was not confined to the "Tokyo-Yokohama" area but would occur wherever there was the combination of heavy industrial complexes surrounded by mountains and where there was a warm ocean current. Such an area exists in the Osaka-Amagasaki-Kobe area. No concrete evidence of a similar type of asthma had been presented up to the time of the present study. It was felt that the reports by Maj. Condit[5, 6] and by Dr. Toyama[11], at least, gave some possibility of finding a similar type of illness in the Osaka area.

Work done during 1964-1965 by Maj. Spotnitz[12] at the United States Army Medical Command, Camp Zama Hospital in Japan, indicated that the syndrome of "Tokyo-Yokohama Asthma" could be separated into three clinical entities: 1. True Asthma: these patients appeared to be sensitized to an atmosphic antigen. They often had acute attacks of dyspnea and wheezing, and an increased eosinophile count in the blood, responded to bronchodilators with significant improvement, but went into a resistant state if they remain in the area. They developed a remission if placed in a filtered air room, but relapsed on returning to an unfiltered atmosphere. On leaving the Tokyo area, they usually had no further asthma. 2. Acute Bronchitis: these patients usually developed coughing and wheezing associated with acute respiratory infections. The disease was more severe than physicians were accustomed to seeing in other areas and was often misdiagnosed as asthma. There was no increase in eosinophiles of the blood. The pulmonary function tests might be abnormal and response to bronchodilators was modest. Although the disease was found to extend over 4 more weeks, it was self-limiting and complete recovery occurred even with continued residence in the Tokyo area. 3. Chronic Obstructive Pulmonary Disease: the group had pre-existing lung damage often of marked degree. They were found to have cough and wheeze associated with infections of the bronchial tree or were found to develop asthma as in the Group 1 patients. They improved in a filtered atmosphere

or on leaving the Tokyo area, but since they had chronic lung disease, pulmonary function tests remained abnormal and it was felt that they would have difficulty in any other part of the world.

With the aid of history, differential blood count, chest x-ray, sputum culture and cytology examination, pulmonary function tests and response to therapy in a filtered air atmosphere, it was felt that in the present study, it would be possible to separate the patients into the 3 clinical entities described above. Using these methods, a systematical investigation of respiratory illness in Osaka was undertaken to determine whether air pollution induced asthma did exist in this area.

Osaka has many features which mimic Tokyo and therefore made it an ideal city to investigate the problem. There is a fairly stable population of over 3.5 million and there is a large concentration of industry in the Amagasaki area. It is ringed by mountains and has a bay which makes it very similar geographically to the Tokyo-Yokohama area. Smog is a frequent problem; ie. in Decmeber, an average of 12.9 days.

2. Analysis of the Problem:

Having seen the patients who were evacuated from Japan in 1946, because of so-called "Tokyo-Yokohama Asthma" while I was stationed at Oliver General Hospital in Augusta, Georgia, I was familiar with the problem. At that time, I was in charge of the Allergy Clinic and we did extensive skin testing, of course using American Antigens, and found that the evacuated personnel did not show any consistent sensitivity to the testing. At that time, of course, we had no idea of extensive lung damage in any of these patients and spirometric studies were not done. However, it can be stated that usually by the time the personnel had arrived at Oliver General Hospital, all symptoms had cleared and their histories certainly bore out the reports mentioned above, ie. that upon leaving Japan the symptoms practically immediately cleared.

The problem in our thinking was two fold as far as the "Tokyo-Yokohama Asthma" syndrome was concerned: 1. Was this a separate and distinct entity? 2. Was this problem present only in the Tokyo-Yokohama area?

1. I think that we can definitely say that this is not a single entity but probably from the very beginning of 1946 when this problem first appeared, it is very likely true that in the first 10 years of study of the problem, the syndrome was mixed up between true asthma, acute bronchitis with allergic symptoms, and chronic obstructive pulmonary disease with allergic symptoms. In analyzing this particular part of the problem, it is felt that: the eosinophile count, chest x-ray, sputum culture, pulmonary function tests(using a bronchodilator and reviewing the response to this), and then using the filter-

ed air room with electrostatic precipitator and a reverse cycle air conditioner to keep the room the same temperature throughout the year, would make it possible to differentiate the originally called "Yokohama-Asthma" syndrome into three separate entities. 2. The reports of Maj. N. I. Condit[5,6] from Okinawa and the report of Dr. Toshio Toyama[11] from Keio University in Tokyo would appear to speak strongly for this type of problem occurring in other areas as well as in the Tokyo-Yokohama area.

In order to further investigate these two problems, the present study was undertaken.

3. Outline of Experimental Procedure:

Patients seen at the Yodogawa Christian Hospital, Osaka, Japan, with a history of cough and/or wheezing for 3 or more days when first seen in the clinic for that illness, were evaluated as potential cases of air pollution respiratory disease. A standardized questionnaire was filled out(see Appendix page 17), a complete blood count was performed, sputum was obtained for culture and cytology, a 6 ft. PA chest x-ray was obtained, and pulmonary function tests were performed before and after administration of a bronchodilator. Complete physical examination was done by a physician. Other diseases such as tuberculosis, cancer, bronchiectasis, and pneumonia were excluded.

The pulmonary function tests were performed by a technician specially trained for the study through the courtesy of Lt. Col. William Wilson of the Camp Zama Hospital. The results were evaluated in accordance with the standard procedures used by the Camp Zama Hospital. In the second year of study, gas analysis, helium dilution method, was used in addition to the usual pulmonary function studies.

As pulmonary function results have been standardized throughout the world, controls were not felt to be necessary for these examinations.

4. Statistical Analysis of Data:

All of the data was placed on graph paper with a standardized key so that each person was evaluated according to the following: A. patient identification, B. past respiratory history, C. presenting respiratory distress, D. physical and laboratory findings, E. spirometric findings. (see Appendix page 27 for complete description of the questions which were coded).

Analysis of the data was then broken down according to various relationships(see 5. Results of the Study and Tables I through XII in the Appendix).

Further opportunity for studying the relationship of air pollution to respiratory illness was given through the use of equipment furnished by the United States Department of Public Health, Division of Air Pollution. This equipment allowed us to measure SO_2 and particulates in the clean air rooms and in the outside air. (see Appendix Figures 1, 2, and 3.) In addition, because of the problem of bacterial complications of the usual viral respiratory illnesses, we did bacterial counts in the rooms to see if the electrostatic precipitators was effective in eliminating this problem(see Tables XIII and XIV in the Appendix.)

5. Results of the Study:

In the original protocol it was assumed that we would have 500 cases of respiratory illness suitable for survey for the study. However the two years covered by the study have been "lean years" as far as respiratory illnesses have been concerned. Dr. R. J. M. Horton, of the Division of Air Pollution of the Public Health Service, in a discussion with the principle investigator noted that in the United States there appeared to be a relationship between the incidence of influenza and the incidnece of bronchitis. Table I shows the number of deaths from influenza, pneumonia, and bronchitis as reported in Osaka Prefecture during the past 10 years[13]. From the table, it can be seen that the winters of 1963 and 1964 had very few deaths from influenza compared with 1960 and 1962. This is somewhat true for bronchitis also. In the winters of 1965 and 1966, very few cases of influenza were reported and we have found that we have had a very small number of cases of bronchitis also. This fact was also true at Camp Zama Hospital, as reported by Col. Wilson in a personal communication to the author. This would seem to bear out Dr. Horton's observation.

During the 2½ years of the study, we had 146 cases of respiratory illness cases in the clinic and complete results are available on 124 cases. During this time, there have been 28 cases admitted to the hospital for complete work up as well as because of the serious nature of their illnesses.

Table II shows the distribution of the 124 cases by age and sex. It can be seen that there are approximately equal distribution of percentage between the 20 to 29, 30 to 39, 40 to 59 and 60 to 69 age groups. Each of these having approximately 20% of the total cases. However, it should be noted that in the total male to female ratio that males are almost 63% of the total. Only in the 30 to 39 age group was the male to female ratio about the same.

Table III shows the previous allergic and pulmonary disease history and the present occupation. Approximately 75% of the cases had a personal allergic history and also a bronchitis history. Only about 25% of the cases had a previous history of pneumonia. In a highly industrialized area, such as Osaka, it is not surprising that about 40% of the cases were from factory workers. The 35%, who were

either housewives or children, do not work in factories and only 15% of the total of 124 cases were office workers.

Table IV is a composite table taken from our original complete records on each patient(see Appendix page 27 for the description of the coded questions for each patient) and represents the important findings which we are concerned with in the present study. Even though a large number of spirometric studies were done on all our patients, $FEV_1\%$ were taken as being one test which more closely correlates to disturbances in ventilatory function[14, 15]. It can be seen from the Table that the largest number(13) of abnormal tests, less than 55% $FEV_1\%$, was found in the age 60 and above male group. The male 60 and above cases represented a smoking years history of over 31 years in 17 cases. 10 cases smoking 11 to 20 cigarettes a day. There were 12 cases with a positive allergic family history. 11 of the cases were factory workers. 19 had abnormal physical findings. 15 had normal eosinophile counts. 22 of the cases in this group, ie. all, had significant positive sputum cultures. 21 out of the 22 had abnormal x-ray findings. 15 out of the 22 had sedimentation rates which were above normal for males, 20 out of 22 had a diagnosis of chronic bronchitis. 21 had a response to treatment. 16 improved with isuprel but only 9 had spirometric improvement, as would be expected.

Table V shows the initial spirometric findings in 124 cases. 40 patients in the second year were studied for residual volume using the closed system helium dilution method. In the measurements of residual volume, Voren, et al.[6] showed that there was no significant difference between the helium dilution and the open circuit nitrogen washout methods. In the Table column 3 represents definite abnormal findings and column 2 shows borderline abnormal findings. In the group of 124 patients, the MMEF showed definite abnormal findings in 47 cases, the MVV in 23, and the % FVC in 6, whereas the $FEV_1\%$ was abnormal in 27 cases. As previously noted[14, 15], the $FEV_1\%$ was taken as the most representative measurements and this was used throughout the remainder of the tables.

Table VI shows the relationship between the $FEV_1\%$ and the duration of smoking by years. The non-smokers were 58 in number and only 6 of these(10.3%) had a definite abnormal $FEV_1\%$. There were 24 who had been smoking 31 or more years and of these 15(62.5%) had an abnormal $FEV_1\%$.

Table VII shows the relation between $FEV_1\%$ and the daily consumption of cigarettes. In the non-smokers, there were a total of 58 and 7(12.1%) of these had a $FEV_1\%$ that was definitely abnormal. Whereas in those who smoked 11 to 20 cigarettes a day, there were a total of 31 and 11(35.5%) of these had a definite abnormal $FEV_1\%$

Table VIII shows the relation between $FEV_1\%$ and diagnosis. The most striking finding in this table is in the chronic bronchitis group where there were 45 patients and 19(42.2%) showed a definitely abnormal $FEV_1\%$. Practically none of the acute bronchitis cases had a

definitely abnormal $FEV_1\%$. There were 50 cases of bronchial asthma and 7(14%) had an abnormal $FEV_1\%$.

Table IX shows the relation between the $FEV_1\%$ and occupation. It is interesting that, in spite of our feeling that factory workers would be more liable to have respiratory impairment from their occupational hazards, the 31 office workers showed the highest number of cases, 10(32.2%), of abnormal $FEV_1\%$. The factory workers were 49 in number and 12(24.5%) of these showed abnormal $FEV_1\%$. The housewives and students were 44 in number and only 5(11.4%) of these had an abnormal $FEV_1\%$.

Table X shows the effect of Isoproterenol on 30 cases of chronic bronchitis. Of the 9 cases whose $FEV_1\%$ was normal at the time of testing, there was improvement in 7. In the borderline cases of $FEV_1\%$, 7 of the 8 improved. The most striking feature of this table is that in about an equal number, there was improvement; no change or even a worsening of their condition. Therefore, it could be said that in the cases where there were a definitely abnormal $FEV_1\%$ in the beginning that Isuprel would not change this drastically.

Table XI shows the effect of Isoproterenol given by IPPB on spirometric studies. The table shows the relationship of the $FEV_1\%$ to % FVC, MMEF and % MVV. It can be seen that the closest correlation in these spirometric studies is between the $FEV_1\%$ and % FVC. The most marked improvement after Isuprel administration was also in the % FVC.

Table XII shows results of the helium dilution methods in 29 cases. The numbers studied are not sufficient for any conclusions to be drawn from this but it is of interest to note that the markedly impaired $FEV_1\%$ group did show the largest number with an abnormal percent RV and an abnormal RV-TLC%

Tables XIII, XIV, and Figures 1, 2 and 3 are not strictly part of the air pollution study but they are a part of any report and, therefore, included for information.

Table XIII shows bacteria counts in the special rooms that were set up for the study and in an ordinary room during a 4 day period. This was set up in order to compare the efficiency of air conditioning, air conditioning and electrostatic precipitator, and neither. Room 315 with only the air conditioner had the lowest bacterial count on 3 out of the 4 days. This was a complete surprise to us as we had assumed that the electrostatic precipitator would be efficient in removing bacteria. Correspondence with the National Center for Air Pollution Control[17] informed us that the bacteria were being produced in the room and as long as there was not recirculation to the electrostatic precipitator, we could not expect efficiency in removing the bacteria from the air.

Table XIV showed a comparison of bacterial counts in the rooms with the outside air at different times of the same day. There

was no great difference in the rooms and no pattern was established but there was a marked increase in bacteria in the outside air as one might expect with the temperature increasing and as there is more movement of air as the day progresses.

Figures 1, 2, and 3 are part of the help given to us by the United States Public Health Service, Division of Air Pollution and represent the SO_2 levels and the particulate counts using an SO_2 bubbler. Fig. 1 gives a compariosn of SO_2 concentrations and dust particulates in a room with air-conditioning but without an electrostatic precipitator. A comparison with Fig. 2 shows that the use of an electrostatic precipitator does decrease the amount of particulate matter but that there is no great change in the SO_2 levels. Reference is made to Mr. F. B. Benson's communications to me of February 2, 1967, showing that the Trion Electrostatic Precipitator is not efficient in removing SO_2 with the charcoal filters which are designed for this unit[17].

Fig. 3 shows the large amounts of SO_2 and particulates in the outside air. It is obvious that the air-conditioning and electrostatic precipitators do remove a great deal of the air pollutants which are present. It is also noted in Fig. 3 that the levels of SO_2 found at the Osaka City Hygiene Institute are much higher than those found at the Yodogawa Christian Hospital. The Hygiene Institute is located in an area where there are many more factories but the meaning here is clear that there is an air pollution problem in the neighbourhood of this hospital.

A study of the carbon filters which were being used in the present study was attempted at the United States Public Health Service, Division of Air Pollution[18] and the filters submitted found to contain numerous compounds or classes of compounds. They were only able to track this pollution down to indicate the presence of at least 40 compounds or classes of compounds that were found in the filter. It was impossible to separate these and, therefore, positive identification could not be carried out.

6. Conclusions:

In the discussion of the analysis of the problem that we were trying to answer in the present study, there were two questions:
1. was "Tokyo-Yokohama Asthma" a separate and distinct entity? and,
2. was this problem present only in the Tokyo-Yokohama area?

During the past 2½ years, we have had a total of 146 cases of respiratory illness which have been evaluated in order to try to answer the above questions. We have complete data on 124 of these cases and 28 cases were hospitalized from 1 to 8 times.

One of the difficulties which we have faced during this 2½ years, and the same situation was also found at the Camp Zama Hospital where Lt. Col. William E. Wilson was investigating the same type of

problem, was that cases of bronchitis and respiratory illness were remarkably few during the winter months during the time that the present study was operating.

Table I shows that there were fewer death from Influenza, Pneumonia, and Bronchitis in Osaka Prefecture in 1963 and 1964 than in the years of 1960 and 1962.

Table III shows that 75% of the cases had personal previous allergic history and bronchitis history.

In such a study as this, where a large number of pulmonary function tests are done, one must decide which spirometric parameter gives the best information to be used for comparison. Taking the findings of others[14, 15], we used the $FEV_1\%$ as the one test which most closely correlates to disturbances in ventilatory function. We found from Table IV that the largest number(13) of abnormal results, less than 55% $FEV_1\%$, were found in the age 60 and above male group. This group also showed the longest smoking history and the heavier smokers were also in this group. Normal eosinophile counts were found in over half of the 22 cases in this group. All had significant positive sputum cultures showing chronic lung disease. 21 had abnormal x-ray findings, and 20 out of the 22 had a diagnosis of chronic bronchitis. Only 9 out of the 22 had spirometric improvement. These findings would certainly go along the supposition that older age individuals who smoke would have more pulmonary disability than the younger age group. Table VI shows this relation still better in that only 10.3% of the non-smokers had an abnormal $FEV_1\%$ whereas 62.5% of the smokers, smoking more than 31 years, had an abnormal $FEV_1\%$. Also Table VII shows that in those who smoke 11 to 20 cigarettes a day, there were 35.5% with a definite abnormal $FEV_1\%$ whereas in the non-smoker group only 12.1% had an abnormal $FEV_1\%$.

Table VIII shows the striking finding that the chronic bronchitis group had 42.2% with a definite abnormal $FEV_1\%$ whereas practically none of the acute bronchitis cases showed this. Only 14% of the bronchial asthma cases had an abnormal $FEV_1\%$.

Table X shows that in cases of chronic bronchitis, where there was a definite abnormal $FEV_1\%$ in the beginning, that Isuprel would not change this drastically.

As an ancillary part of the study, equipment supplied to us by the United States Public Health Department, Air Pollution Division, enabled us to study the SO_2 and particulate levels in our clean air rooms. A personal communication[17] from Mr. F. B. Benson helped us to understand why we were not obtaining practically zero levels of air pollutants in our clean air room. This was because the charcoal filters furnished with the Trion Electrostatic Precipitator are not efficient in removing SO_2. It is concluded that an efficient charcoal filtration system must be used in clean air rooms of a better type than that supplied by the Trion Company in their MAC-25 Model.

In the Appendix page 53 is shown 4 examples of plant damage from air pollution. These plants were exposed to the atmosphere during the Spring of 1967 and show the damage which occurs in the area of the hospital. In the Appendix page 55 is shown 2 pictures taken from the same place, on top of hospital, with the same camera setting. One shows the 9 a.m. visibility and the other the 3 p.m. visibility on a clear day, October 17, 1966. The amount of air pollution is evident when these pictures are compared.

In the Appendix page 50, there are 4 case reports of cases while we felt most closely answered the questions that we were interested in in the present study.

Case No. 1(Appendix page 50) was a case of acute bronchitis complicated by air pollution and the clean air environment was of marked benefit to this patient in his recovery.

Case No. 2(Appendix page 51) was a case of acute bronchitis which was felt to be completely uncomplicated by air pollution but which did demonstrate the remarkable benefit to the patient of treatment in the clean air room.

Case No. 3(Appendix page 51) was a case of chronic obstructive lung disease and also demonstrates benefits from clean air environment even though the underlying pathology was not greatly improved.

Case No. 4(Appendix page 52) was a case of bronchial asthma and again demonstrated the effectiveness of a clean air room environment in allergic pulmonary problems in addition to bronchodilators which are normally used in the treatment of bronchial asthma.

Even though our cases were not sufficient in number to actually make clear cut conclusions or answer the questions which were discussed in the analysis of the problem and also noted in the beginning of the present section, it is felt that we can say that at this time that we would agree with Spotnitz[12] that the syndrome of "Tokyo-Yokohama Asthma" is not a separate and distinct entity but rather embraces 3 clinical entities: 1. true asthma, 2. acute bronchitis, and 3. chronic obstructive pulmonary disease(usually thought of as chronic bronchitis in the sense of this particular syndrome and problem).

Regarding question 2. about the problem being present only in the Tokyo-Yokohama area, it is felt that the cases found here with a definite relation to air pollution and the clearing of their problem in a clean air environment with a return of their problem when they go back into a polluted atmosphere, allows us to reach the conclusion that this type of problem is present also in the Osaka area. It is admitted that this cannot be definitely proven on the basis of the small number of cases studied during this time but there is sufficient evidence from the case reports presented that these patients definitely fit the categories described by Spotnitz[12].

7. Implications of Conclusions:

It is felt that the previously described syndrome of "Tokyo-Yokohama Asthma" is not a single and distinct entity but as pointed out by Spotnitz[12], there are 3 clinical entities involved in this syndrome: 1. true asthma, 2. acute bronchitis, 3. chronic obstructive pulmonary disease. It is further felt that these clinical entities, seen as complications of air pollution, may be present in any part of the world where there is a combination of highly industrialized area, surrounded by mountains and having a sufficient body of water to cause air circulation to and from the mountain areas.

8. Contributions to Theory:

It has been pointed out that the syndrome of "Tokyo-Yokohama Asthma" is probably a misnomer and that it is probably three separate and distinct clinical entities which can be separated on the basis of questionnaire, laboratory results, and spirometric studies. It is also felt that the reports of Condit[5, 6] and Toyama[11] as well as the present study would bear out the fact that these separate entities are not only present in the Tokyo-Yokohama area but also present in Okinawa and other areas of Japan. The present study would indicate that this type of problem is also present in the Osaka area.

It is planned to continue the study of the relationship of air pollution to respiratory illnesses in a hospital population. This institution has requested the United States Army and Research Development Program to grant the Yodogawa Christian Hospital the use of this equipment during an additional 5 year period. The United States Public Health Department, Division of Air Pollution, has agreed to continue to loan this hospital the air pollution measurement equipment which they have supplied to us.

It is felt that more detailed work needs to be done in the relationship of air pollution to these respiratory illnesses and particularly to study over time cases which appear to be complicated by air pollution to see if their pulmonary function is adversely influenced by air pollution.

9. Bibliography

1 406th Medical General Laboratory Annual Report for 1950.

2 406th Medical General Laboratory Annual Report for 1951.

3 "Etiology of Yokohama Asthma," A Preliminary Report by P. L. Redfearn and J. A. Karakawa, Medical Bulletin, U. S. Army, Far East, June 1953.

4 "New Environmental Respiratory Disease, Yokoahama Asthma," Preliminary Report by T. E. Huber et al., Industrial Hygiene and Occupational Medicine, pp. 399-408, 1954.

5 "Progress Report on Machinato-Naha Asthma," N. I. Condit, Proceedings of the Public Health Council of Okinawa, May 21, 1957.

6 "The Changing Face of Okinawa Asthma, " N. I. Condit, Proceedings of Public Health Council of Okinawa, Enclosure 1, pp. 1-8, June 1958.

7 "Air Pollution Asthma Among Military Personnel in Japan, Some of the Clinical Characteristics of this Disease and Therapeutic Measures that seem to give Patients most Relief," H. W. Phelps et al., JAMA, 175-990, March 18, 1961.

8 "Tokyo-Yokohama Asthma, and Area Specific Air Pollution Disease," R. B. W. Smith et al., Archives of Environmental Health, 8:805, June1964.

9 "Air Pollution Asthmatic-Bronchitis Among United States Personnel in Japan," H. W. Phelps, Japan Heart Journal, 2:180, April 1961.

10 "Tokyo-Yokohama Asthma, A Rapid Development of Respiratory Distress Presumably due to Air Pollution," H. W. Phelps and S. Koike, American Review of Respiratory Disease, 86:55, July 1962.

11 "Air Pollution and It's Health Effects in Japan," Toshio Toyama, presented to the 6th Air Pollution Medical Research Conference, January 28, 1963, Calif. State Dept. of Public Health

12 "The Significance of Yokohama Asthma," Murray Spotnitz, The American Review of Respiratory Disease, 92:3 Sept. 1965.

[13] "Vital Statistics 1956" through "Vital Statistics 1965" published by Health and Welfare Statistics Division, Minister's Secretariat, Ministry of Health and Welfare, Tokyo.

[14] "Clinical Spirometry", Recommendations of the Section on Pulmonary Function Testing, Committee on Pulmonary Physiology, American College of Chest Physicians, Disease of the Chest, Vol. 43, No. 2, p. 214, Feb. 1963.

[15] "The Veterans Administration Cooperative Study of Pulmonary Function III. Mortality in Relation to Respiratory Function in Chronic Obstructive Pulmonary Disease," A. D. Renzetti, Jr. et al., American Journal of Medicine, Vol. 41, July 1966, p. 115.

[16] "The Veterans Administration - Army Cooperative Study of Pulmonary Function No. II. The Lung Volume and Its Subdivisions in Normal Men," H. G. Voren et al., American Journal of Medicine, Vol. 41, July 1966, p. 96.

[17] Personal Communication from Mr. F. B. Benson, National Center for Air Pollution Control, dated February 2, 1967.

[18] Memorandum from T. R. Hauser to Dr. R. O. McCaldin dated May 25, 1966.

10. Appendixes

APPENDIX A

Evaluation Summary Used for all Patients in the Study

NOTES

A. Family History: "Family" means: Parents, siblings, off spring.
"Other Allergy" means: Atopic eczema, edema, rhinitis or urticaria.

B. 1. Severity: (1) Not require medical care.
(2) Not (1) or (3).
(3) Emergency OPD or hospitalized.

5. Bronchitis means: Severe infectious respiratory illness requiring services of a doctor.

10. Severity: (1) Climb of 1 flight of stairs causes symptoms.
(2) Climb of more than 1 flight of stairs causes symptoms.

C. 5. Severity: (0) No treatment
(1) Self medication, loss of sleep, fatigue, OPD care.
(2) Hospitalized.

D. 3. Means more than twice over 5% eosinophilia.

4. Significant means: A-hemolytic strep., B-hemolytic strep, coag. pos. staph., H-influenzae, or diplo-pneumonia.

5. Felsen-Roent. of chest, definitions, widening spaces flat, diaphragm.

(1) Emphysema
(2) Bronchitis: Irregularity of larger bronchi, increased broncho-vascular markings.
(3) Bronchiectasis-Cysts, lower segments and increased broncho-vascular markings.

10. Diagnosis - Doctors' judgment.

11. (1) is not (0) or (2).

A. IDENTIFICATION

1. Date picked by present study:_____

2. Name:_____

3. Age:_____

4. Place of Work (1-9):_____

5. Place of Residence (1-9):_____

6. Date of arrival in Osaka area(number of months ago)

1. Whole life	____	6. 25 to 30 months	____
2. 1 to 6 months	____	7. 31 to 36 months	____
3. 7 to 12 months	____	8. 3 to 5 years	____
4. 13 to 18 months	____	9. 5 years plus	____
5. 19 to 24 months	____		

7. Prior Osaka Residence: (1) Yes ____ (2) No____

8. Cigarette Smoking History:

Onset: (0) Never ____ (3) Age 21 to 25 ____
(1) Prior to age 15 ____ (4) Age 26 plus ____
(2) Age 15 to 20 ____

Maximum smoking:

(0) None	____	(5) 31 to 35	____
(1) 1 to 10	____	(6) 36 to 40	____
(2) 11 to 20	____	(7) 40 plus	____
(3) 21 to 25	____	(8) Pipe	____
(4) 26 to 30	____	(9) Cigar	____

Years smoked: _____ years.

Present intake: (0) Has not smoked for at least one year____

(1) 1 to 10	____		
(2) 11 to 20	____	(6) 36 to 40	____
(3) 21 to 25	____	(7) 40 plus	____
(4) 26 to 30	____	(8) Pipe	____
(5) 31 to 35	____	(9) Cigar	____

9. Family History: Asthmatic: (1) Yes____ (2)No____
Other allergy: (1)Yes____ (2) No____
Bronchitis or emphysema: (1) Yes____
(2) No____

10. Duration of Observation by Study(number of month)_____

B. PAST RESPIRATORY HISTORY

1. Asthma: (1) Yes____ (2) No____

   Duration: (0) Infancy only ____
   (1) Up to age 12 only ____
   (2) With only mild trouble after age 12 ____
   (3) Steadily since childhood ____

   Severity: (0) Mild____ (1) Moderate____ (2) Severe____

2. Hay Fever: (1) Yes____ (2) No____

3. Eczema: (1) Yes____ (2) No____

4. Positive Allergy History: (1) Yes____ (2) No____

5. Bronchitis:(up to age 21)
   (0) Never____ (1) 1 to 4 times ____
   (2) 5 times or more____

6. Bronchitis:(age 21 and over)
   (0) Never____ (1) 1 to 4 times ____
   (2) 5 times or more____

7. Known Bronchiectasis: (1) Yes____ (2) No____

8. Proven Paranasal Sinus Disease:
   (0) None____ (1) Catarrhal____
   (2) Purulent(doctor's drainage)____

9. Coughs:

   Onset: (number of years ago)_____

   Persistence: (0) Year round ____
   (1) Winter only ____
   (2) Pollen season____

   Character: (0) Dry ____
   (1) Semi-productive____
   (2) Purulent ____
   (3) Unrecorded ____

   Severity: (0) Mild____ (1) Moderate ____
   (2) Paroxysmal____

10. Unexplained Dyspnea:

    Onset: (number of months ago)_____

    Persistence: (1) Yes____ (2) No____

B. 10. Unexplained Dyspnea (continued)

Progression: (0) None____ (1) Progressive____

Severity: (0) At rest____ (1) On mild effort ____
(2) On strenuous effrot____

C. PRESENTING RESPIRATORY DISTRESS

1. Type: (0) New____ (1) Aggravation ____
(2) Recrudescence____

2. Onset: (number of months ago)_____

3. Relationship to Osaka area arrival:

Prior to: (1) Yes____ (2) No____

Subsequent to: (1) Yes____ (2) No____

Number of months_____

During prior Osaka residence: (1) Yes____ (2) No____
(3) Not apply____

4. Periodicity: Daily: (0) Uniformly around clock____
(1) Worse at night ____
(2) Worse in morning ____
(3) Nocturnal only ____
(4) Morning only ____

Yearly: (months of severe attacks)
(0) Year round ____
(1) Fall & winter ____
(2) Spring & summer____
(3) Fall only ____
(4) Winter only ____
(5) Spring only ____
(6) Summer only ____

Character of remission: (0) None ____
(1) Partial ____
(2) Almost complete____
(3) Complete ____

5. Severity:

General: (0) Mild____ (1) Moderate ____
(2) Crippling____

Emergency treatment required: (1) Yes____ (1) No____

C. 5. Severity(continued)

Hospitalization: (0) None _____ (3) 3 times _____
(1) 1 time _____ (4) 4 times _____
(2) 2 times _____ (5) 5 times or more _____

6. Symptom:

Cough: Severity: (0) None _____ (2) Moderate _____
(1) Mild _____ (3) Severe _____

Character: (0) None _____ (2) Mucosa _____
(1) Dry _____ (3) Purulent _____

Wheeze: Severity: (0) None _____ (2) Moderate _____
(1) Mild _____ (3) Severe _____

Character: (0) None _____ (1) Inspiratory _____
(2) Expiratory _____

Dyspnea: Severity: (0) None _____ (2) Moderate _____
(1) Mild _____ (3) Severe _____

7. Treatment Response(subjective):

Drugs: (1) Yes _____ (2) No _____

Filtered Air Room: (0) Not used _____ (1) Yes _____
(2) No _____

Steroids: (0) Not used _____ (1) Yes _____ (2) No _____

D. FINDINGS

1. Obvious Respiratory Distress: (0) Not recorded _____
(1) Yes _____
(2) No _____

2. Positive Chest Findings: (0) Normal _____
(1) Emphysematosis only _____
(2) Wheezing _____
(3) Rhonchi _____
(4) Prolonged expiratory phase _____

3. Peripheral Eosinophilia: (1) Yes _____ (2) No _____

4. Significant Culture studies: (0) None _____
(1) Occasional _____
(2) Persistent _____

D. FINDINGS(continued)

5. Chest X-ray: (0) Normal ____ (2) Bronchitis ____
(1) Emphysematous ____ (3) Bronchiectasis ____

6. EKG: (0) Not obtained ____ (1) Normal ____ (2) Abnormal ____

7. Associated Respiratory Abnormalities:
(0) None ____
(1) Vasomotor rhinitis ____
(2) Paranasal sinusitis ____

8. Evidence of Emotional Problem or Disorder:

(0) Absent ____ (2) Mild ____
(1) Questionable ____ (3) Severe ____

9. Other Medical Problems(by name): _____

_____

10. Primary Respiratory Diagnoses:

	(0)Absent	(1) Mild	(2)Modr'te	(3)Severe
Bronchitis, chronic	____	____	____	____
Bronchitis, acute	____	____	____	____
Asthma extrinsic	____	____	____	____
Asthma intrinsic	____	____	____	____
Emphysemia, pulmonary	____	____	____	____
Bronchiectasis	____	____	____	____

11. Response to Treatment:

Drugs: (0) None ____ (1) Moderate ____ (3) Cleared ____

Disease Determination: (0) None ____
(1) Moderate ____
(2) Cleared ____

E. SPIROMETRIC FINDINGS

1. External: FVC % of predicted ____
FEV_1% of FVC ____
MMEF in liters ____
MVV % of predicted ____

2. Effect of Isuprel: (0) None Significant ____
(1) Significance 10% plus ____
(2) Return to Normal ____

E. SPIROMETRIC FINDINGS(continued)

3. Helium Equilibration: RV % of predicted _____
TLC % of predicted _____
RV/TLC as percent _____

4. Summary: Treatment Response:

Subjective: (0) None _____
(1) Moderate _____
(2) Cleared _____

Objective: (0) None _____
(1) Moderate _____
(2) Cleared _____

Spirometric: (0) None _____
(1) Moderate _____
(2) Cleared _____

APPENDIX B

Table I

Deaths in Osaka Prefecture
from Selected Respiratory Illnesses, 1956-1965

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Influenza	4	40	47	30	227	64	229	8	13	187
Pneumonia	441	500	1,319	1,369	1,702	1,404	1,517	1,177	1,281	1,591
Bronchitis	38	35	176	242	299	262	300	233	222	268

Table II

Distributions of Subjects by Age

	M	F	Total	%
1 - 9	7	2	9	7.3
10 - 19	5	5	10	8.0
20 - 29	17	9	26	21.0
30 - 39	14	13	27	21.8
40 - 59	13	10	23	18.5
60 - 69	18	7	25	20.2
70 -	4	0	4	3.2
Total	78	46	124	100

Table III

Previous History and Present Occupation

		Number of Cases	% of 124 Cases
Allergy History of Patient		92	74.2
Allergy History of Family		75	60.5
Pneumonia History		30	24.2
Bronchitis History		92	74.2
Occupation	Factory Worker	49	39.5
	Office Worker	31	15.0
	Household (Children)	44	35.5

KEY FOR TABLE IV

SMOKING		Family Allergy History	Occupation	P.X. Finding	Eosinophiles over 5%	Sputum Culture	X-ray Finding	Sed Rate	Diagnosis	FEV_1%	Effect of Isoproterenol	Spirometric Response	Response to Treatment
Duration by Years	Daily Consumption												
1. No.	1. No.	1. Yes	1. Factory Worker	1. Abnormal	1. Over	1. Not Significant	1. Normal	1. 1-10 mm	1. Asthma	1. Over 71%	1. No.	1. No.	1. No.
2. 1-10	2. 1-10	2. No.	2. Office Worker	2. Normal	2. Normal	2. Significant	2. Abnormal	2. 11-20 mm	2. Chronic Bronchitis	2. 70-56%	2. Yes	2. Yes	2. Yes
3. 11-20	3. 11-20												
4. 21-30	4. 21-30		3. Other Household					3. 21 - mm	3. Acute Bronchitis	3. Less than 55%			
5. over 31	5. over 31												

Table IV Classification by Age.

Age	Sex	Smoking Years		Present (intake)	Fam. Aller. History		Occu-pation		P.X. Finding		Eosino-philes	
		1	11	11								
		2	0	0	1	8	1	0	1	6	1	8
	M	3	0	0								
		4	0	0			2	0				
		5	0	0	2	3			2	5	2	3
							3	11				
		1	4	4								
		2	0	0	1	3	1	0	1	3	1	4
	F	3	0	0								
		4	0	0			2	0				
14		5	0	0	2	1			2	1	2	0
							3	4				
15		1	5	5								
		2	19	12	1	18	1	20	1	23	1	21
	M	3	9	13								
		4	0	3			2	13				
		5	0	0	2	15			2	10	2	12
							3	0				
		1	21	21								
		2	3	3	1	19	1	5	1	20	1	16
	F	3	1	1								
		4	0	0			2	4				
39		5	0	0	2	6			2	5	2	9
							3	16				
40		1	1	1								
		2	0	3	1	9	1	9	1	13	1	3
	M	3	1	8								
		4	5	1			2	4				
		5	6	0	2	4			2	0	2	10
							3	0				
		1	8	8								
		2	2	2	1	4	1	3	1	10	1	6
	F	3	0	0								
		4	0	0			2	1				
59		5	0	0	2	6			2	0	2	4
							3	6				
60		1	3	4								
		2	0	6	1	12	1	11	1	19	1	7
	M	3	1	10								
		4	1	1			2	8				
		5	17	1	2	10			2	3	2	15
							3	3				
		1	4	4		2	1	0				
		2	0	2	1				1	4	1	3
	F	3	0	0			2	1				
		4	1	0								
		5	1	0	2	4	3	5	2	2	2	3

Sex, etc. of 124 patients.

Culture		X-Ray		Sed Rate		Diag-nosis		Temp.		General Effect		Spirem. Response		Resp. to Treat'nt	
1	3	1	5	1	3	1	10	1	9	1	2	1	2	1	0
—		—		2	6	2	1	2	1	—		—		—	
2	8	2	6	3	2	3	0	3	1	2	3	2	9	2	11
1	0	1	2	1	1	1	4	1	2	1	0	1	1	1	0
—		—		2	3	2	0	2	2	—		—		—	
2	4	2	2	3	1	3	0	3	0	2	3	2	3	2	4
1	0	1	9	1	25	1	15	1	21	1	2	1	10	1	0
—		—		2	4	2	6	2	7	—		—		—	
2	35	2	24	3	4	3	12	3	5	2	24	2	18	2	33
1	0	1	12	1	5	1	14	1	23	1	6	1	6	1	0
—		—		2	7	2	3	2	2	—		—		—	
2	25	2	18	3	13	3	8	3	0	2	11	2	13	2	25
1	0	1	2	1	7	1	0	1	5	1	3	1	7	1	0
—		—		2	3	2	10	2	2	—		—		—	
2	13	2	11	3	3	3	3	3	6	2	7	2	6	2	13
1	1	1	4	1	2	1	5	1	1	1	3	1	4	1	0
—		—		2	1	2	0	2	8	—		—		—	
2	9	2	6	3	7	3	5	3	1	2	6	2	7	2	10
1	0	1	1	1	7	1	0	1	6	1	3	1	12	1	1
—		—		2	6	2	20	2	3	—		—		—	
2	22	2	21	3	9	3	2	3	13	2	16	2	9	2	21
1	0	1	2	1	1	1	2	1	0	1	1	1	3	1	0
—		—		2	2	2	4	2	5	—		—		—	
2	6	2	4	3	3	3	0	3	1	2	3	2	3	2	6

Table V

Initial Spirometric Findings

	% FVC	FEV_1%	MMEF	% MVV	% RV	RV/TLC%
1	More than 81 104	More than 71 68	More than 3.0 (l/sec) 33	More than 81 60	Less than 119 20	Less than 35 18
2	51 - 80 14	56 - 70 29	1.1-2.9 (l/sec) 44	51 - 80 41	120 - 169 15	36 - 49 16
3	Less than 50 6	Less than 55 27	Less than 1.0 (l/sec) 47	Less than 5.0 23	More than 170 5	More than 50 6
Total	124	124	124	124	40	40

Table VI

Relation Between $FEV_1\%$
and Duration of Smoking by Years

Year \ $FEV_1\%$	More than 71%	70 - 56 %	Less than 55%
0	35	17	6
1 - 20	24	8	4
21 - 30	2	2	2
31 -	6	3	15

Table VII

Relation Between FEV_1% and
Daily Consumption of Cigarettes

FEV_1% / Number	More than 71 %	71 - 56%	Less than 55 %
0	34	17	7
1 - 10	15	6	8
11 - 20	14	6	11
21 -	4	1	1

Table VIII

Relation Between $FEV_1\%$ and Diagnosis

$FEV_1\%$ / Diagnosis	More than 71 %	70 - 56%	Less than 55 %
Asthma	27	16	7
Chronic Bronchitis	16	10	19
Acute Bronchitis	24	4	1

Table IX

Relation Between $FEV_1\%$ and Occupation

Occupation \ $FEV_1\%$	More than 71 %	70 - 56 %	Less than 55 %
Factory Worker	26	11	12
Office Worker	15	6	10
Other(Housewife, Student)	26	13	5

Table X

Effect of Isoproterenol on
30 Cases of Chronic Bronchitis

FEV_1%	Improved	No Change	Deteriorated
More than 71 %	7	1	1
70 - 56%	7	1	0
Less than 55 %	5	4	4

Table XI

Effect of Isoproterenol Given by IPPB
on Spirometric Studies in 85 Cases

		% FVC		MMEF		% MVV	
		Normal	Ab-normal	Normal	Ab-normal	Normal	Ab-normal
1 Normal FEV_1% Over 71 (38 Cases)	Before	37	1	15	23	30	8
	After	43	2	20	25	33	12
2 Slightly Impaired FEV_1% 56 - 70 (26 Cases)	Before	17	9	0	26	6	20
	After	15	6	1	20	7	14
3 Markedly Impaired FEV_1% Less than 55 (21 Cases)	Before	13	8	0	21	0	21
	After	14	5	0	19	0	19
Total	Before	67	18	15	70	36	49
	After	72	13	21	64	40	45

Table XII

Helium Dilution Method in 29 Cases

	% FVC		MMEF		% MVV		% RV		RV/TLC %	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
1 Normal FEV_1% Over 71 (12 Cases)	12	0	5	7	8	4	6	6	5	7
2 Slightly Impaired FEV_1% 56 - 70 (10 Cases)	6	4	0	10	1	9	3	7	3	7
3 Markedly Impaired FEV_1% Less than 55 (7 Cases)	6	1	0	7	0	7	1	6	2	5
Total	24	5	5	24	9	20	10	19	10	19

APPENDIX C

Table XIII

Bacterial Counts in the Special Rooms and in an Ordinary Room During a 4 Day Period

Day Number / Room	1		2		3		4	
	Center	Total	Center	Total	Center	Total	Center	Total
315 (AC)	11	71	10	50	29	169	10	90
313 (AC & EP)	5	18	22	70	50	437	13	116
311 (N)	19	58	10	35	26	88	42	151

Center: Means 1 place at center of room.

Total: Means 5 places, 1 center and 1 at each corner.

AC: Air Condition

EP: Electric Precipitator

N: Neither

Table XIV

Bacterial Counts in the Rooms and on the Roof
at Different Times of the Same Day

	1 (AC)	2 (AC & EP)	3 (N)	4 (N)
I	12	14	30	35
II	12	21	4	Many
III	15	6	14	-

Time:

I: 9:30 - 19:30
II: 2:00 - 2:30
III: 8:00 - 8:30

Room:

1: 315
2: 313
3: 311
4: Roof

AC: Air Conditioned
EP: Electric Precipitator
N: Neither

APPENDIX D

Figure 1
Comparison of SO_2 Concentrations and Dust Particulates
in Room No.315 during November 1966 (without Precipitator)

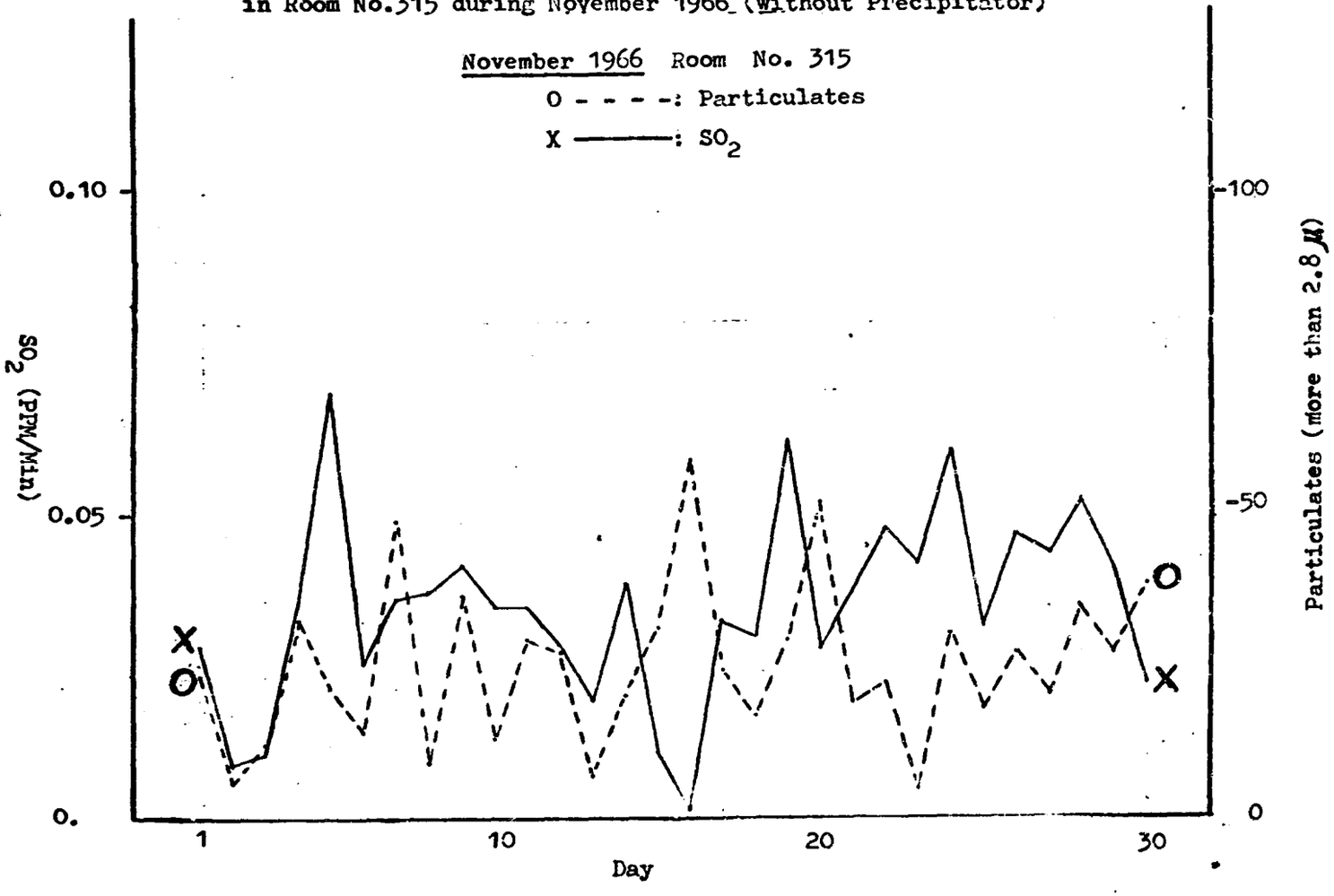


Figure 2

Comparison of SO_2 Concentrations and Dust Particulates in Room No. 313 during November 1966 (With Precipitator)

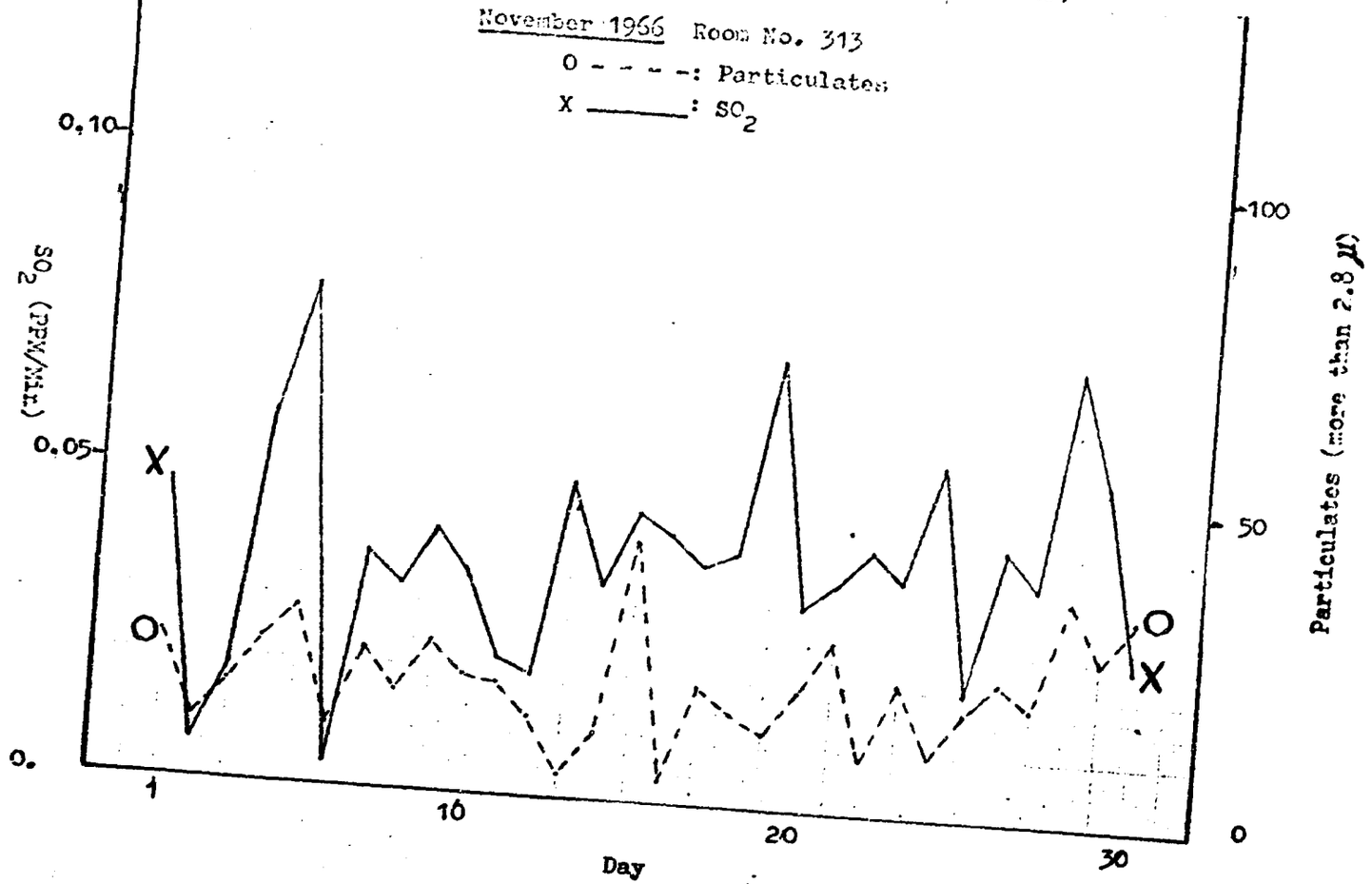
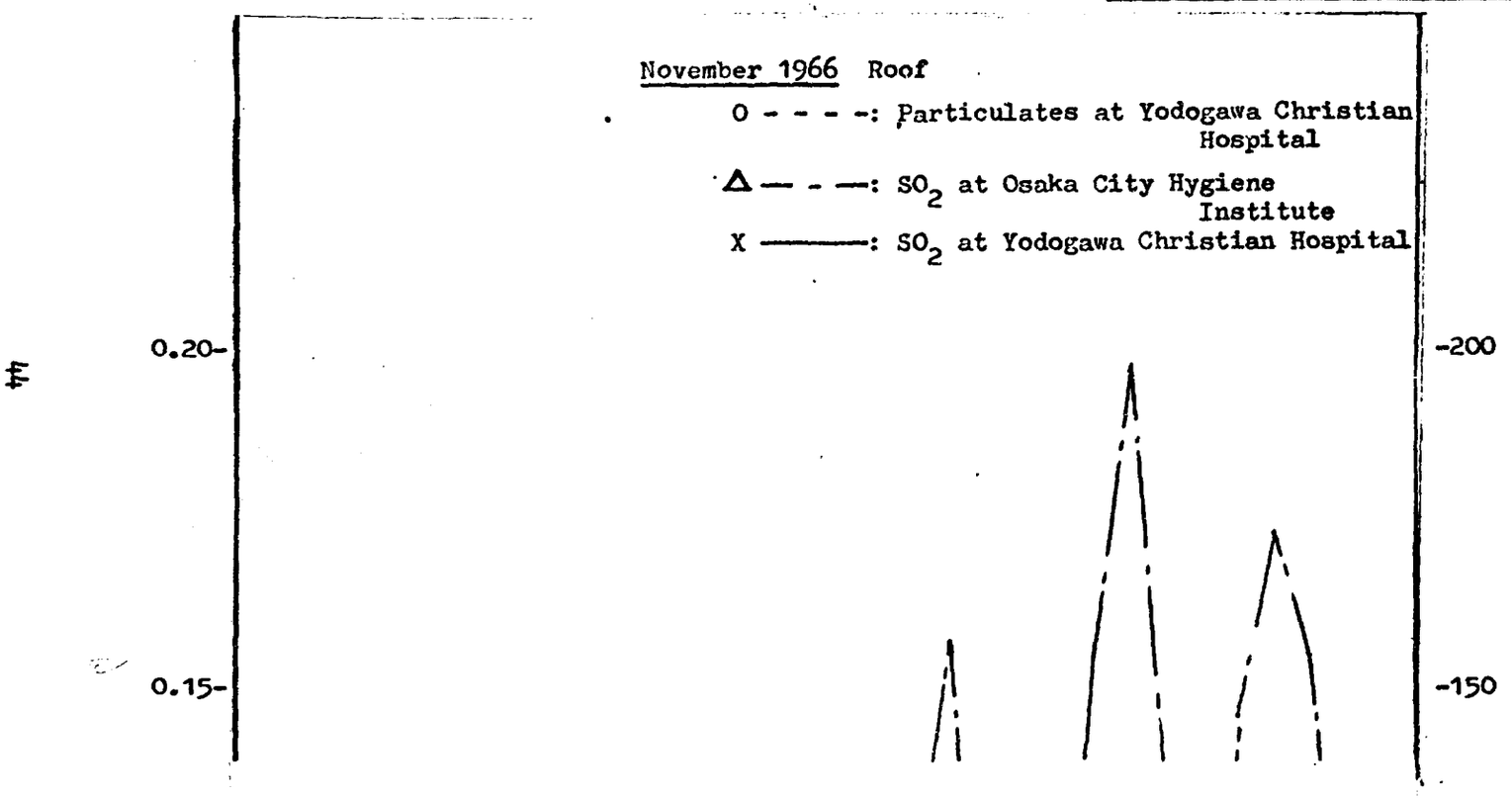
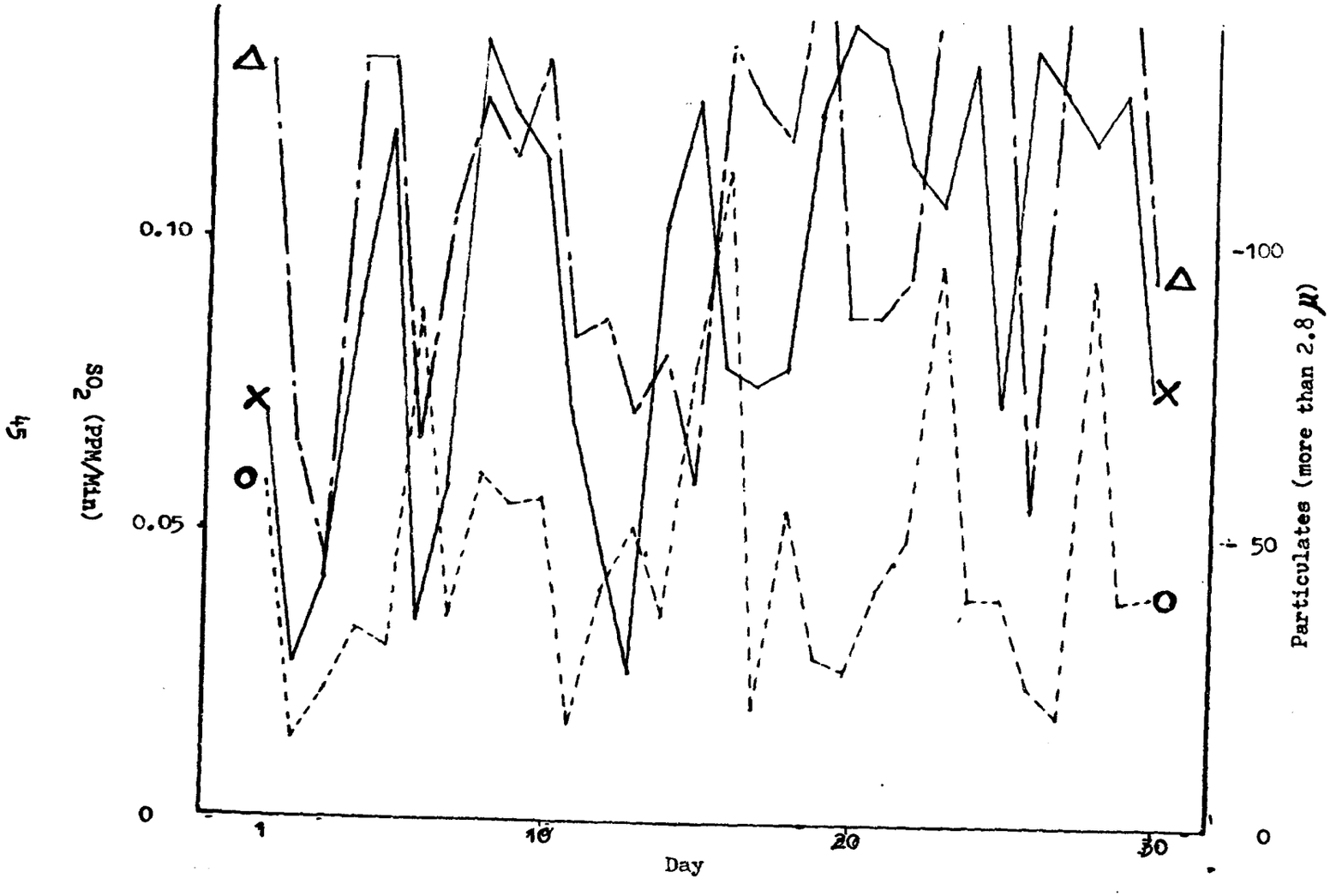


Figure 3

Comparison of SO_2 Concentrations and Particulates on the Roof of the Hospital and SO_2 Concentrations at Osaka City Hygiene Institute During November 1966

	Yodogawa Chris. Hosp.	Osaka City Hyg. Inst.
Max.	0.1393	0.1980
Min.	0.0260	0.0450
Ave.	0.0943	0.1120




Δ
X
O
0.10
0.05
0
1
10
20
30
Day
SO2 (PPM/Min)
Particulates (more than 2.8 μ)
100
50
0

APPENDIX E

Personal Communication from Mr. F. B. Benson to the Principal Investigator.
(Bibliography No. 17)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

NATIONAL CENTER FOR
AIR POLLUTION CONTROL
1055 Laidlaw Avenue
Cincinnati, Ohio
45237

February 2, 1967

REFER TO:

Ovid B. Bush, Jr., M. D.
Yodagawa Christian Hospital
57, Awaji honmachi, 1-chrome
Higashi Yodogawa-ku
Osaka, Japan

Dear Ovid:

I contacted the local Trion Company representative in Cincinnati concerning your air cleaning problems. Mr. Cheney said that the electrostatic filter is highly effective in removing the bacteria that get to it. Apparently, your problem of finding more bacteria in the room with the precipitator can be explained because the precipitator is cleaning only the incoming air from outside - it is not cleaning your inside air.

The charcoal filters used on your unit do not make sufficient contact with the air to scrub out the SO_2. Because of the honeycomb design, only about 10% of the air makes contact with the charcoal. To efficiently remove SO_2 he stated that a charcoal filter bed of at least one inch thickness would be required. However, the blower on your unit does not have sufficient capacity to pull air through this much resistance.

I am enclosing his letter and other information about particulate and bacteria removal.

I hope you can come by Cincinnati to see us this summer.

Sincerely yours,

Ferris

Ferris B. Benson
National Center for Air
Pollution Control

APPENDIX F

Copy of Communication from Mr. T. R. Hauser to
Dr. R. O. McCaldin
(Bibliography No. 18)

UNITED STATES GOVERNMENT

Memorandum

TO : Dr. Roy O. McCaldin DATE: May 25, 1966

FROM : Tom R. Hauser

SUBJECT: Analysis of Carbon Filters from Japan

Summation of Memo

The chloroform extract of the honeycombed carbon filters used to clean the air of the "clean air room: in Japan was found to contain numerous compounds (or classes of compounds) when analyzed by gas chromatography. Further separation and identification of the compounds contained in the extract would be very difficult and time consuming project that would demand the use of analytical equipment that we do not readily have at our disposal.

Laboratory Work Performed

The carbon filter as received from Japan and a new, unused carbon filter (used for the blank determination) were processed in the following manner.

Twelve $3\frac{1}{2}$" diameter circles were cut out of the filter using a $3\frac{1}{2}$" hole saw. The circles were then stacked in a large Soxhlet apparatus and extracted with chloroform for three eight hour periods over a duration of three days. The time period for each extraction cycle was approximately forty minutes. The chloroform was then removed from the extract by use of a rotary flash evaporator and a vacuum oven.

Once each extract was dry, a portion was redissolved in chloroform and subjected to gas chromatography on an SE -30 column. After determining column parameters, the sample was injected into the column at 50° C. The column was maintained isothermally at 50°C for a period of about three minutes in order to remove solvent and other low boiling components common to both sample and blank. The column was then temperature programed to increase in temperature at a rate of 6°C per minute and the chromatogram was continued until the temperature reached 250°C. The chromatograms indicated the presence of at least 40 compounds (or classes of compounds) on the filter used in the clean air room that were not present on an unused filter.

The separation, isolation, and identification of the components present on the filter could probably be best solved by using the principles of gas chromatography, collecting the effluent fractions separated by the gas chromatograph, and then determining the spectral characteristics (eg. infra-red, ultra-violet, visible, and mass spectra) of the individual fractions. To say the least, it would be a difficult and time consuming operation. Our laboratory is not equipped to perform the necessary experimentation at the present time.

APPENDIX G

CASE REPORTS

1. Case No. 76, H. Y.: The patient was a 36 year old male tin foil factory worker and was seen in the Out-Patient Department on November 17, 1965, with the complaint of sore throat and cough.

Past History: There was a mild cough during the preceding winter but no wheezing. There was no family history of allergy and the patient's previous allergy history was negative. He was born in Osaka City and lived in this city all of his life. He worked in the same factory for the past 12 years.

Smoking History: He has been smoking for 15 years and the average consumption has been 5 cigarettes a day.

Physical examination on his first visit revealed a reddish throat and moderate piping in the lungs. Bronchodilator, expectorant and sulfisoxole were given. 5 days later the patient was admitted to the hospital(A room with electrostatic precipitator) because of worse wheezing and cough. From the 3rd hospital day, the patient was feeling much better except for a mild cough in the early morning and physical examination showed no piping in the day time. From the 6th hospital day, the patient had no more cough even in the early morning. Then on the 9th hospital day, the patient was discharged. 2 days later the patient came to the Medical Out-Patient Department because of wheezing and cough. 5 days later, the patient had to be hospitalized again (B room without electrostatic precipitator). 2 days later the patient was slightly better but still had moderate wheezing. Such symptoms continued and, on the 7th hospital day, the patient was transferred back to A room. Within 2 days the patient was feeling much better and physical examination showed no more piping.

On December 24, 1965, 18th hospital day, the patient went home as he was much improved and because of the Christmas Holidays, but the patient returned to the hospital in 2 days with wheezing and cough(A room with electrostatic precipitator). 5 days later the patient again became better and was discharged on medication: Penicillin V-oral, bronchodilator and cough medicine. 6 days later (January 6, 1966) patient came to the special clinic for this study and complained of cough in the early morning but physical examination showed no piping in the lungs.

Spirometric studies showed acute obstructive lung disease ($FEV_1\%$, 53. This improved to 83% during the time he was in the clean air room).

The patient was fairly well until February 2, 1966, when again sore throat, productive cough and wheezing occurred. On February 3,

he had to be hospitalized because of progression of his symptoms. In B room without electrostatic precipitator, his symptoms did not completely disappear and, one week later, bronchodilator and antihistamine drugs were given. He was discharged on February 17, 1966. Upon discharge, he again began to wheeze but much milder than previously. In March of 1966, he changed his work from the tin foil manufacturing part of the factory and thereafter had no recurrence.

This patient shows sensitivity to the materials that he had been working with, probably over the time he has become sensitive to zinc or some other element of tin foil manufacture.

This case demonstrates the benefit of clean air environment in recovery from acute bronchitis, complicated by air pollution.

2. Case No. 103, S. K.: This patient was a 20 year old male who has been followed in the Neurosurgical Department because of the epilepsy and a congenital A-V fistula in the left frontal lobe which was operated on in 1960.

On December 30, 1965, he developed nasal discharge, sore throat and productive cough. On January 7, 1966, he came to the Medical Out-Patient Department and was hospitalized when physical examination revealed moist rales in his right lung. Sedimentation rate and white blood count were normal. X-ray showed bronchitis. Spirometric studies were normal.

The only treatment was the clean air room and from the 4th hospital day, his subjective and objective symptoms improved and he was discharged on the 15th hospital day. Diagnosis was acute bronchitis and this case demonstrates the benefit of clean air room treatment for uncomplicated acute bronchitis.

3. Case No. 104, T. I.: This patient was a 53 year old male iron factory worker who came to the Out-Patient Department on January 5, 1966, because of 3 day duration of productive cough. There were moist rales in both lungs on physical examination and cough medicine and Tetracycline were prescribed.

He has been working in the iron factory since 1929.

He began smoking at the age of 21 and average consumption was 10 cigarettes a day. There was no family history of allergy.

Two days later, he was admitted to the hospital as an emergency case because of a severe wheezing, cough and dyspnea. Physical examination on admission showed wheezing audible in the both lungs and there were moist rales. Previous medication was continued and bronchodilators were not used. From the following day, his subjective, objective and spirometric findings progressively improved day by day and,

on the 12th hospital day, he was discharged. He occasionally had a productive cough but the wheezing did not recur. His $FEV_1\%$ was 58 on admission and even though subjectively he had marked improvement, his $FEV_1\%$ only came up to 68. Thus this case demonstrates chronic obstructive lung disease.

He was rechecked in the OPD on 4 occasions for mild cough. This case shows that an acute exacerbation of chronic obstructive lung disease markedly benefits from clean air environment even though the underlying pathology is not greatly improved.

4. Case No. 123, E. K.: The patient was a 28 year old housewife who came to the Medical Out-Patient Department because of an 8 day history of dyspnea and wheezing on March 9, 1966.

She was born in Kagoshima Prefecture on Kyushu. She came to Otsu City in Shiga Prefecture in 1953, where she worked in a fiber factory. She had a history there of asthmatic symptoms or wheezing after catching cold. In 1960, she went to Wakayama Prefecture, where she had no asthmatic symptoms.

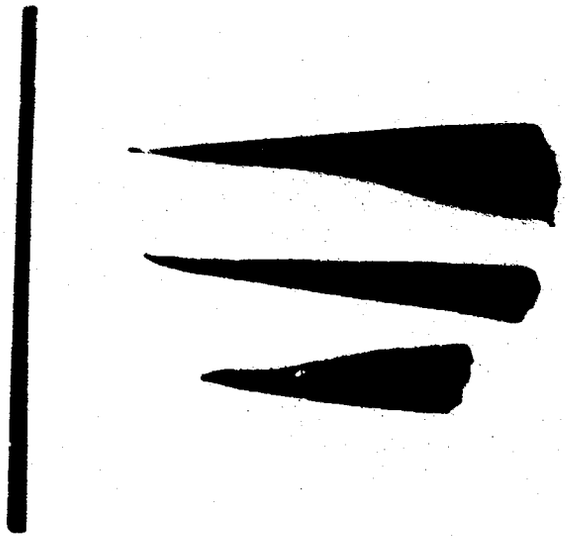
There was a previous history of contact dermatitis and skin rash after drugs. She showed sensitivity to the house dust but denied family history of allergy and she did not smoke.

In May of 1965, she was married and moved to Osaka City. Around the 1st of March, 1966, she developed cough and wheezing and was admitted to the hospital on March 9, 1966. At the time of admission, the blood showed a marked increase in eosinophiles(15%). Her forced expiratory spirogram showed a slightly obstructive pattern (FEV_1%58%, MMEF was 0.51l/sec., and MPFR was 140 l/min).

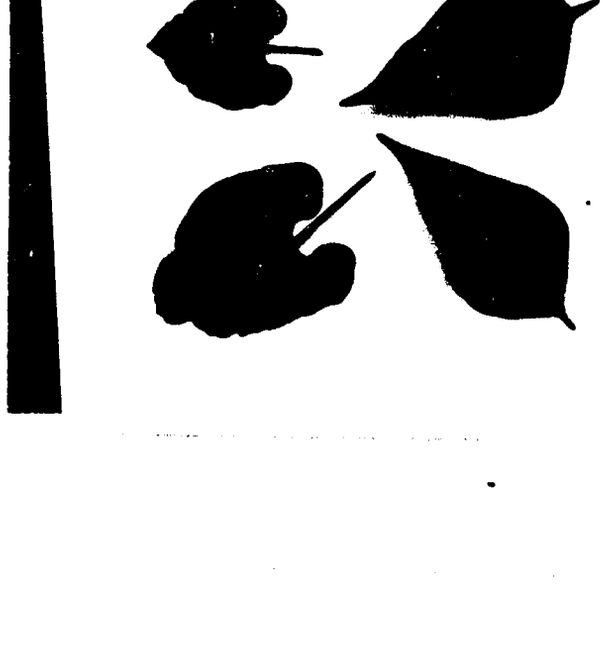
Over the next several months, there were 8 admissions to the clean air room and on each occasion with the use of bronchodilators, expectorants, antibiotics and steroids, she promptly cleared, and upon leaving the hospital, she was completely free of symptoms but she started wheezing immediately after she returned home and had to be re-admitted.

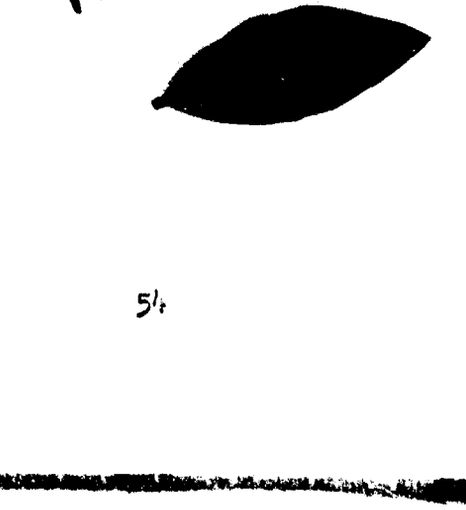
Each occasion showed exactly the same results: soon after admission, the symptoms cleared and when she went back home, they recurred but on re-admission the symptoms cleared again in the clean air environment.

This case demonstrates obstructive lung disease due to allergy. It clearly demonstrates the effectiveness of a clean air environment in allergic pulmonary problems in addition to the bronchodilators used in the treatment of bronchial asthma.



Plant Air Pollution Damage(2)

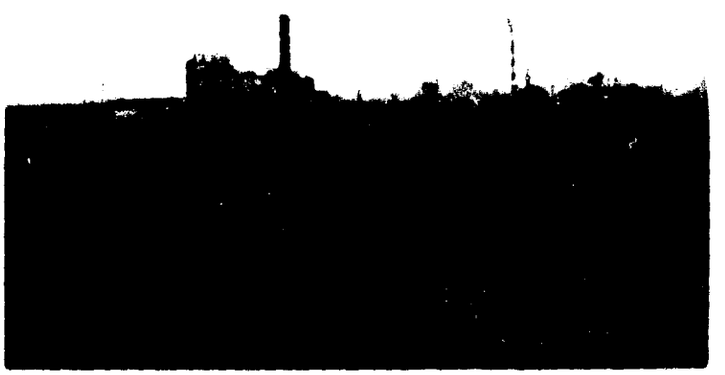




APPENDIX I

Visibility at 9 a.m. and 3 p.m. on Same Day

9 a.m.



3 p.m.

occur in the Osaka area and we would suspect that they would occur in any area where there is a high level of air pollution and during seasons when there is a large number of respiratory illnesses. We have been unfortunate in not having large numbers of respiratory illnesses during the time of the study but we have been able to satisfy ourselves that there is a connection between air pollution and the severity and complications of respiratory illnesses. (Author)

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13. ABSTRACT

During the past two and a half years, we have been studying two problems: The first: was the syndrome of "Tokyo-Yokohama Asthma" a separate and distinct syndrome or was it a group of three clinical entities? These three entities were: a. true asthma, b. acute bronchitis, and c. chronic obstructive pulmonary disease. The second: whether the syndrome of "Tokyo-Yokohama Asthma" could be found in Osaka as well as in the Tokyo-Yokohama area?

We have intensively studied 146 patients and have complete records on 124. There have been 28 patients admitted to the hospital for from 1 to 8 times for intensive care and study. A standardized questionnaire, physical examination, laboratory tests, and spirometric studies, as well as the use of air conditioners and electrostatic precipitators for clean air rooms were used to evaluate these problems. The United States Public Health Service, Division of Air Pollution, also supplied equipment to us for measuring SO_2 and particulate levels.

We have found cases of each of the three clinical entities mentioned above. The cases have shown a response to the clean air environment and upon return to their homes some have again had respiratory difficulties. We have thus been able to answer to our satisfaction that the syndrome of "Tokyo-Yokohama Asthma" is in reality three distinct clinical entities and not a single syndrome. We have also been able to establish to our satisfaction that the clinical entities described above do

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